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(54) Air conditioner.

(57) An air conditioner comprises a housing having upper and lower intermediate platform members 51,52 which divide the housing into sections, an evaporator 10 arranged in the upper section, a condenser 30 arranged beneath the evaporator 10 in the lower section, a pair of cross fans 40,41 operated by a single fan motor, and screens 100,200 disposed selectively at front or rear faces of the evaporator 10 and the condenser 30. When cooling, the screen 100 for the evaporator 10 is positioned adjacent the rear face of the evaporator and the screen 200 for the condenser is positioned adjacent the front face of the condenser - and when heating, vice versa. When in cooling operation, the condensate of the evaporator 10 drops onto the condenser 30 through drain passages formed in the intermediate platform members 51,52.

The air conditioner achieves cooling and heating without changing the cooling and heating cycle. Further, the air conditioner achieves high efficiency during cooling due to the condensate flow down across the condenser.

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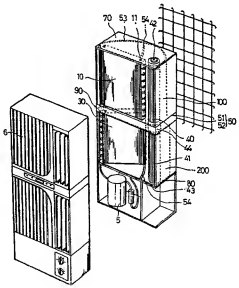

EP 0 534 805 A2

The present invention relates to air conditioners.

Figure 1 of the accompanying diagrammatic drawings illustrates a conventional air conditioner with an evaporator 10, a condenser 30 facing one face of the evaporator, an integral stationary casing 1 disposed longitudinally between the evaporator and the condenser, and cross fans 40,41 for guiding air flow toward the evaporator 10 and the condenser 30 respectively. At respective upper and lower ends of the casing 1, respective upper and lower frames 2,3 are located. Under the lower frame 3 are disposed fan motors (not shown) which are connected to the cross fans, respectively. Further, under the lower frame 3 is disposed a compressor 5 for compressing and discharging a refrigerant. On the upper frame 2 are engaged supporting members 42,43 which support the upper shafts of the cross fans, respectively. Cooling air is discharged through a grill 6. A filter 7 removes dust from the air flow.

However, a problem occurs because the evaporator and the condenser are juxtaposed along their faces causing the width of the air conditioner to become too massive. In the instalment of the air conditioner in a wall, a significant protruding portion of the air conditioner from the wall requires extra support means, such as brackets and the like, which detracts from the appearance of the air conditioner. Further, two fan motors are required for rotating the pair of cross fans.

In order to resolve the problem, an air conditioner has been developed and disclosed in Japanese Utility Model Publication No. 1986 - 39233. The air conditioner comprises a casing located in a place where indoor air intakes though a front portion and discharges through the same portion, and a casing located in a place where outdoor air is taken in though a rear portion and discharged through the same portion. Heat exchangers are stacked intersectedly and cross fans are coaxially disposed one above the other. Between the upper cross fan and the lower cross fan is placed a transmission for rotating the cross fans reversibly. A fan motor is placed at one end of the fans and at the opposite end of the transmission.

This arrangement reduces the size of the air conditioner.

However, the air conditioner requires an additional changeover device for reversing the flow of the refrigerant in order to heat as well as cool the air flowing through it. Furthermore, the condensate generated by the evaporator drops down onto an intermediate platform and drains out through a drain passage formed in the platform without any further use to the air conditioner, which decreases the efficiency of the air conditioner.

Preferred embodiments of the present invention seek to provide an air conditioner which easily and effectively solves the above mentioned problems.

An aim of preferred embodiments of the present invention is to provide an air conditioner in which both cooling and heating are achieved in one system without reversing the flow of the refrigerant in the system.

Another aim is to provide an air conditioner in which condensate formed in an evaporator drops down to a condenser so as to increase heat loss therefrom.

According to one aspect of the present invention, an air conditioner system comprises an evaporator and a condenser which are pivotally disposed respectively in a reverse manner within a predetermined range by a swing member which is coupled to an end of the evaporator and that of the condenser in a same direction. Further, the air conditioner may comprise screen members arranged so as to travel back and forth between the front face of the evaporator and that of the condenser and the rear face of the evaporator and that of the condenser. An upper screen for the evaporator and a lower screen for the condenser may travel in a reverse manner by means of a travelling member which is connected to both ends of the screens. Furthermore, in a frame there may be formed intermediate platform members over which is disposed the evaporator and under which is disposed the condenser. The intermediate platform members may comprise an upper platform having a condensate drain passage and a lower platform having a plurality of openings formed along an upper portion of the condenser.

When in a cooling condition, the upper screen member may be positioned adjacent to the rear face of the evaporator, and the lower screen member places adjacent to the front face of the condenser. When in a heating condition, the position of the evaporator and that of the condenser are switched in an intersection direction, and the screen members aligned with the respective opposite faces of the evaporator and of the condenser. That is, the upper screen member is placed adjacent to the front face of the evaporator, and the lower screen member adjacent to the rear face of the condenser. During cooling operation, a condensate generated from the evaporator may drop down to the intermediate platform and the water gathered toward the drain passage sprays the upper portion of the condenser through the openings.

According to another aspect of the present invention, there is provided an air conditioner comprising:

a frame;

an evaporator pivotally disposed in said frame;

a condenser pivotally disposed in said frame and arranged underneath said evaporator;

a pair of fans disposed in said frame for forcibly moving air;

a fan motor operatively connected to each said fan for rotating said fan;

a pair of screen members arranged movably between a front face of said evaporator and a rear face thereof and between a front face of said con-

denser and a rear face thereof, respectively, for guiding air flow; and

control means for pivoting within a predetermined range said evaporator and said condenser and for moving said screen members back and forth.

Preferably, said frame comprises an intermediate platform for separating said evaporator and said condenser, an upper platform formed over the upper part of said evaporator, a lower platform formed under the lower part of said condenser, a rail formed in each platform for guiding movement of said screen, and a groove formed in each platform for restricting the movement of said evaporator and said condenser.

Preferably, said screen members comprise an upper screen member arranged movably back and forth between the front face of said evaporator and the rear face thereof and a lower screen member arranged movably back and forth between the front face of said condenser and the rear face thereof.

Preferably, said upper screen member and said lower screen member respectively comprise a screen, a pair of vertical rods for fixing respectively both vertical ends of said screen, a pair of horizontal flexible rods encompassing respectively upper and lower horizontal portions of said screen, a plurality of supporting rods disposed in said screen for reinforcing said screen, and a plurality of actuators connected to said control means for moving respectively said screen members between the front face of said evaporator and the rear face thereof and between the front face of said condenser and the rear face thereof.

Preferably, a travelling member in said control means comprises an upper travelling shaft connected to said evaporator, a lower travelling shah connected to said condenser, and a stepping motor for operating simultaneously said upper travelling shaft and said lower travelling shaft in a reverse manner.

Preferably, a swing member in said control means comprises an upper swing shaft disposed at an end of said evaporator, a lower swing shah disposed at an end of said condenser, and a stepping motor for operating simultaneously said upper swing shaft and said lower swing shaft in a reverse manner.

According to a further aspect of the present invention, there is provided an air conditioner having a housing which is partitioned into two sections, an evaporator disposed in an upper section of said sections, a condenser disposed in a lower section of said sections, a cross fan disposed in said housing to cooperate with said evaporator and said condenser, and a fan motor connected to said cross fan, characterized in that said evaporator and said condenser are arranged to move in a reverse manner within a predetermined range by means of a pivot member which is coupled to an end of said evaporator and an end of said condenser and screens are arranged so as to travel back and forth between said front faces of said evaporator and said condenser and said rear faces of said evaporator and said condenser, which screens comprise an upper screen for the evaporator and a lower screen for condenser, arranged to travel in a reverse manner by a travelling member which is connected to both ends of said screens.

Preferably, said upper screen is disposed adjacent the rear face of said evaporator, and said lower screen is disposed adjacent the front face of said condenser when in a cooling mode, while said upper screen is disposed adjacent the front face of said evaporator, and said lower screen is disposed adjacent the rear face of said condenser when in a heating mode.

According to another aspect of the present invention, there is provided an air conditioner comprising an evaporator, a condenser, fan means, screen means, and control means for altering the mutual positions of the evaporator, condenser and screen means so as to switch the air conditioner between heating and cooling modes.

An air conditioner as above may further comprise any one or more of the features disclosed in the accompanying specification, claims, abstract and/or drawings, in any combination.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to Figures 2 to 9 of the accompanying diagrammatic drawings, in which:

Figure 2 is a perspective view of one example of an air conditioner embodying the present invention;

Figure 3 is a perspective view of a frame suitable for use in the embodiment of Figure 2;

Figure 4 is a perspective view of a swing member suitable for use in the embodiment of Figure 2;

Figure 5 is a perspective view of a screen member connected to a travelling member, as suitable for use in the embodiment of Figure 2;

Figure 6 is a disassembled perspective view of an intermediate platform member suitable for use in the embodiment of Figure 2;

Figure 7A is a plan view of an evaporator compartment in a cooling condition, in use of the embodiment illustrated in Figures 2 to 6;

Figure 7B is a plan view of a condenser compartment in a cooling condition, in use of the embodiment illustrated in Figures 2 to 6;

Figure 8A is a plan view of the evaporator compartment in a heating condition, in use of the embodiment illustrated in Figures 2 to 6;

Figure 8B is a plan view of the condenser compartment in a heating condition, in use of the embodiment illustrated in Figures 2 to 6;

Figure 9A is an end elevation view of the air conditioner in a cooling condition, in use of the embodiment illustrated in Figures 2 to 6; and

Figure 9B is an end elevation view of the air con-

ditioner in a heating condition, in use of the embodiment illustrated in Figures 2 to 6.

Figures 2 to 6 illustrate an air conditioner in accordance with a preferred embodiment of the present invention.

The air conditioner includes an evaporator 10 and a condenser 30 which are pivotally mounted by a control means 90 with the evaporator 10 arranged over the condenser 30. Between the evaporator 10 and the condenser 30 are disposed intermediate platform members 50 which comprise a lower intermediate platform 52 and a upper intermediate platform 51. An upper platform 70 is disposed over the evaporator 10, and a lower platform 80 is disposed beneath the condenser 30. Screen members 100, 200 comprise an upper screen member 100 for the evaporator 10 and a lower screen member 200 for the condenser 30. The screen members 100,200 are arranged so as to travel back and forth between the front face of the evaporator 10 and the rear face of the -condenser 30 or between the front face of the condenser 30 and the rear face of the evaporator 10. Between the upper intermediate platform 51 and the lower intermediate platform 52 is disposed the control member 90 for pivoting the evaporator 10 and the condenser 30 and moving the screen members 100, 200. Opposite the control member 90 is disposed a fan motor 44 for rotating cross-fans 40, 41 which forcibly move outdoor and indoor air.

On the upper surface of the upper intermediate platform 51 and on the lower surface of the lower intermediate platform 52 a respective rail 53 is formed for guiding travel of the screen embers 100,200, respectively. The configuration of the rail 53 comprises a straight line adjacent a front edge of the upper and lower intermediate platforms 51,52 and a curved line extending from the forward end of the straight line as illustrated at Figure 3. The curved line runs toward a rear edge of the upper and lower intermediate platforms 51,52 and turns to near a starting point of the straight line as illustrated at Figure 3. Further, in the upper surface of the upper intermediate platform 51 and in the lower surface of the lower intermediate platform 52 a respective groove 54 is formed for guiding the travel of roller bearings 11 which are engaged in the upper end edge 10A and a lower end edge 10B of the evaporator and at similar positions in the condenser 30, not shown. At the lower surface of the upper platform 70 and the upper surface of the lower platform 80 a rail 53 and a groove 54 are formed, respectively, having the same configuration as above.

Further, as illustrated in Figure 6, at the upper surface of the upper intermediate platform 51 there is formed an upper drain duct 55 between the rail 53 and the groove 54 for gathering condensate from the evaporator 10.

The upper drain duct 55 has an upper drain passage 56 which is at a lower level of the drain duct 55. At the upper surface of the lower intermediate platform 52 under the upper drain duct 55 is formed a lower drain duct 57 for collecting the condensate therefrom. At the lowest level of the lower duct 57 a plurality of openings 58 are formed for dropping the condensate down to the condenser 30.

At the upper surface of the upper platform 70 and the lower surface of the lower platform 80 are engaged supporting members 42 43, respectively, for supporting the cross fans 40,41. In Figures 4 and 5, the control member 90 includes a pivot member for moving both the evaporator 10 and the condenser 30 within a predetermined range, and a travelling member for pivoting screen members 100,200 back and forth. The pivot member comprises a stepping motor 91 which swings both the evaporator 10 and the condenser 30 within the range of the groove 54. The pivot member also comprises an upper pivot shaft 92 vertically secured to the evaporator 10. One end of the upper pivot shaft 92 is mounted to the upper platform 70 and the other end thereof is connected so as to mechanically communicate with the stepping motor 91 and includes a driving gear 92A. The pivot member also consists of a lower pivot shaft 93 vertically secured to the condenser 30. One end of the lower pivot shaft 93 is mounted to the lower platform 80 and the other end thereof includes a driven gear 93A which is in mechanical communication with the driving gear 92A of the upper pivot shaft 92. The evaporator 10 and the condenser 30 are positioned in a manner so as to pivot in opposite directions relative to each other.

The travelling member comprises a stepping motor 95 which moves screen members 100,200 between the surfaces of the evaporator 10 and those of the condenser 30 back and forth. The stepping motor 95 is disposed near the stepping motor 91 of the pivot member. The travelling member also consists of an upper travelling shaft 96 connected to an upper screen member 100. One end of the upper travelling shaft 96 is pivotally mounted to the upper platform 70 and the other end thereof is connected so as to be in mechanical communication with the stepping motor 95 and extends further downwardly through the stepping motor 95 which further includes a driving gear 96A. The travelling member also consists of a lower travelling shah 97 connected to a lower screen member 200. One end of the lower travelling shaft 97 is pivotally mounted to the lower platform 80 and the other end thereof extends upwardly with a driven gear 97A formed thereon so as to mechanically communicate with the driving gear 96A. The upper travelling shaft 96 and the lower travelling shaft 97 rotate in a reverse manner. When the upper screen member is aligned adjacent to the front surface of the evaporator 10, the lower screen member is aligned adjacent to the rear surface of the condenser 30. When the upper screen member is aligned vice versa, the lower

screen member is aligned vice versa.

The upper screen member 100 and the lower screen member 200 each consist of a screen 101 which has a characteristic of heat insulation. A pair of vertical rods 102 are fixed respectively to both vertical ends of the screen 101. A pair of horizontal flexible rods 103 are encompassed respectively through each upper and lower horizontal end of the screen 101 to permit the screen 101 to travel along the rail 53. The horizontal rod 103 is elastic to help the screen member 100 to travel in a retro or backward position. A plurality of supporting rods 104 are disposed in the screen 101 for reinforcing the screen 101. Each of the vertical rods 102 has rings 105 at the upper portion of the vertical rod 102 and the lower portion thereof, respectively. One end of a string 106 is tied to the ring 105 at the upper portion of the right hand vertical rod 102, and other end of a string 106 is tied to the ring 105 at a corresponding portion of the left hand vertical rod 102, as illustrated in Figure 5. At the lower portion of each vertical rod 102, another string is tied to the vertical rod as above. The string is wound up on the upper travelling shaft 96 so that when the left hand vertical rod 102 of the screen member 100 approaches toward the travelling shaft 96, the right hand vertical rod 102 is retracted away from the travelling shaft 96, and vice versa. In the lower travelling shaft 97, the string 106 is wound up on the lower travelling shaft 97 in the reverse manner in respect to the travelling direction of the vertical rod 102. That is, when the upper screen 100 is placed adjacent to the rear surface of the evaporator 10, the lower screen 200 is placed adjacent to the front surface of the condenser 30. When the upper screen 100 is placed adjacent to the front surface of the evaporator 10, the lower screen 200 is placed adjacent to the rear surface of the condenser 30.

In Figures 7A,7B and 9A, a cooling operation is illustrated.

The evaporator 10 is aligned adjacent to the indoor area as shown in Figure 7A. The upper screen 100 moves along the rail 53 and is disposed adjacent to the outdoors. The indoor air is taken into the air conditioner through the grill by the rotation of the cross fan 40. The intaken air heat exchanges with the evaporator 10. The flow of the air is guided by the screen 100 and is discharged back to the indoors through the cross fan 40.

In Figure 7B, the condenser 30 is aligned adjacent to the outdoors. The lower screen 200 moves along the rail 53 and is disposed adjacent to the indoors. The outdoor air is taken into the air conditioner through the back grill by the rotation of the cross fan 41 and heat exchanges with the condenser 30. The flow of the air is guided by the screen 200 and is discharged back to the outdoors through the cross fan 41. Therefore, the air indoors becomes cool. Furthermore, the condensate generated from the surface of the evaporator 10 drops down to the condenser 30 through the openings 58 formed in the intermediate platforms 50. The condensate increase the heat loss from the condenser 30 so as to increase the efficiency of the air conditioner.

In Figures 8A,8B and 9B, a heating operation is illustrated.

In Figure 8A, the evaporator 10 is moved adjacent to the outdoors along the groove 54 about the upper pivot shaft 92 in a counter-clock direction. The upper screen 100 moves along the rail 53 in a clockwise direction by the same directional rotation of the travelling shaft 96. The upper screen 100 is disposed adjacent to the indoors. The outdoor air is taken into the air conditioner through the back grill by the rotation of the cross fan 40 and heat exchanges with the evaporator 10. The flow of the air is guided by the screen 100 and is discharged back to the outdoors through the cross fan 40. In Figure 8B, with a counter-clockwise rotational direction of the upper pivot shaft 92 as shown in Figure 8A, the condenser 30 is concurrently moved adjacent to the outdoors along the groove 54 about the lower pivot shaft 93 in a clockwise direction. With the clockwise rotation of the upper travelling shaft 96, as shown in Figure 8A, the lower screen 200 concurrently travels along the rail 53 in a counter-clock wise direction by the same directional rotation of the lower travelling shaft 97. The lower screen 200 is disposed adjacent to the outdoors. The indoor air is taken into the air conditioner through the grill by the rotation of the cross fan 41 and heat exchanged by the condenser 30. The flow of the air is guided by the screen 200 and is discharged back to the indoors through the cross fan 41. Therefore, the air indoors becomes warm.

In the above structural air conditioner, the heating and cooling are achieved in one system without reversing the flow of the refrigerant in the system. Further, the condensate of the evaporator is used to increase the efficiency of the cooling mode.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly

stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. An air conditioner comprising:
   a frame;
   an evaporator pivotally disposed in said frame;
   a condenser pivotally disposed in said frame and arranged underneath said evaporator;
   a pair of fans disposed in said frame for forcibly moving air;
   a fan motor operatively connected to each said fan for rotating said fan;
   a pair of screen members arranged movably between a front face of said evaporator and a rear face thereof and between a front face of said condenser and a rear face thereof, respectively, for guiding air flow; and
   control means for pivoting within a predetermined range said evaporator and said condenser and for moving said screen members back and forth.

2. An air conditioner according to claim 1, wherein said frame comprises an intermediate platform for separating said evaporator and said condenser, an upper platform formed over the upper part of said evaporator, a lower platform formed under the lower part of said condenser, a rail formed in each platform for guiding movement of said screen, and a groove formed in each platform for restricting the movement of said evaporator and said condenser.

3. An air conditioner according to claim 1 or 2, wherein said screen members comprise an upper screen member arranged movably back and forth between the front face of said evaporator and the rear face thereof and a lower screen member arranged movably back and forth between the front face of said condenser and the rear face thereof.

4. An air conditioner according to claim 3, wherein said upper screen member and said lower screen member respectively comprise a screen, a pair of vertical rods for fixing respectively both vertical ends of said screen, a pair of horizontal flexible rods encompassing respectively upper and lower horizontal portions of said screen, a plurality of supporting rods disposed in said screen for reinforcing said screen, and a plurality of actuators connected to said control means for moving respectively said screen members between the front face of said evaporator and the rear face thereof and between the front face of said condenser and the rear face thereof.

5. An air conditioner according to claim 4, wherein a travelling member in said control means comprises an upper travelling shaft connected to said evaporator, a lower travelling shaft connected to said condenser, and a stepping motor for operating simultaneously said upper travelling shaft and said lower travelling shaft in a reverse manner.

6. An air conditioner according to any of the preceding claims, wherein a swing member in said control means comprises an upper swing shaft disposed at an end of said evaporator, a lower swing shaft disposed at an end of said condenser, and a stepping motor for operating simultaneously said upper swing shaft and said lower swing shaft in a reverse manner.

7. An air conditioner having a housing which is partitioned into two sections, an evaporator disposed in an upper section of said sections, a condenser disposed in a lower section of said sections, a cross fan disposed in said housing to cooperate with said evaporator and said condenser, and a fan motor connected to said cross fan, characterized in that said evaporator and said condenser are arranged to move in a reverse manner within a predetermined range by means of a pivot member which is coupled to an end of said evaporator and an end of said condenser and screens are arranged so as to travel back and forth between said front faces of said evaporator and said condenser and said rear faces of said evaporator and said condenser, which screens comprise an upper screen for the evaporator and a lower screen for condenser, arranged to travel in a reverse manner by a travelling member which is connected to both ends of said screens.

8. An air conditioner according to claim 7, wherein said upper screen is disposed adjacent the rear face of said evaporator, and said lower screen is disposed adjacent the front face of said condenser when in a cooling mode, while said upper screen is disposed adjacent the front face of said evaporator, and said lower screen is disposed adjacent the rear face of said condenser when in a heating mode.

9. An air conditioner comprising an evaporator, a condenser, fan means, screen means, and control means for altering the mutual positions of the evaporator, condenser and screen means so as to switch the air conditioner between heating and cooling modes.

10. An air conditioner according to claim 9, further comprising any one or more of the features disclosed in the accompanying specification, claims, abstract and/or drawings, in any combination.

FIG.1
(PRIOR ART)

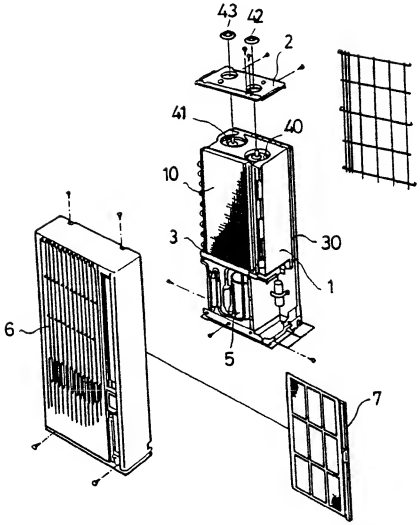

FIG. 2

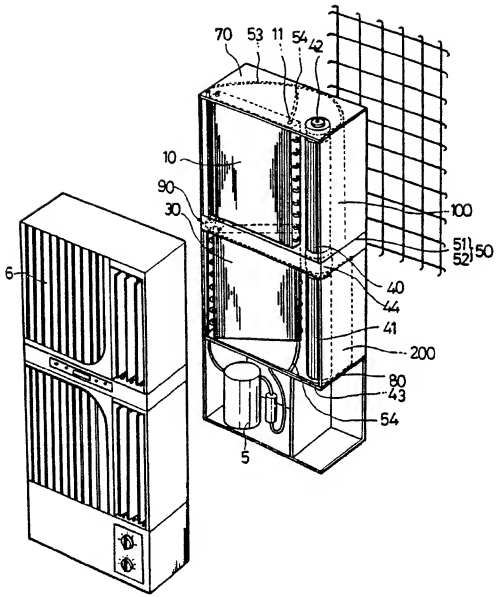

FIG.3

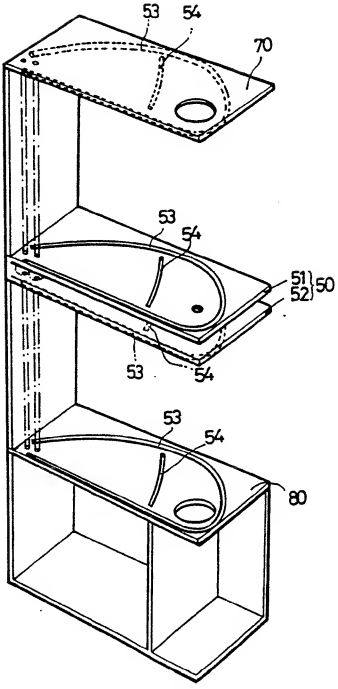

FIG.4

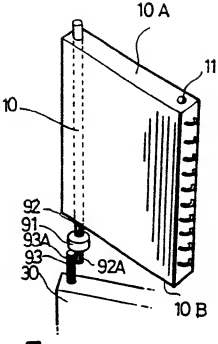
10 A
11
10
92
91
93A
93
92A
30
10 B

FIG.5

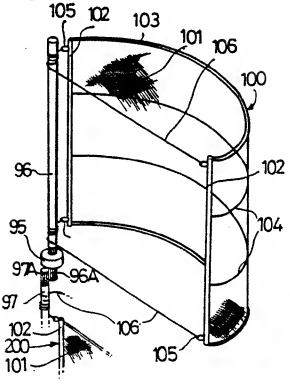
105
102
103
101
106
100
96
102
104
95
97A
96A
97
106
102
200
101
105

FIG. 6

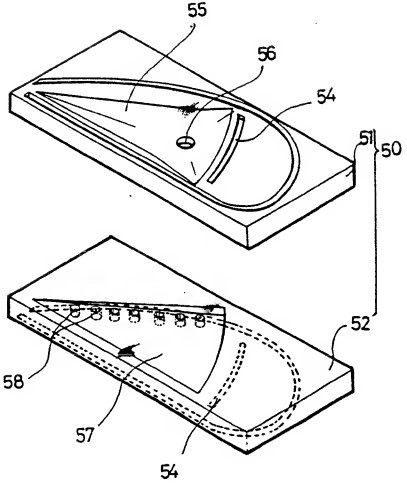

FIG.7A

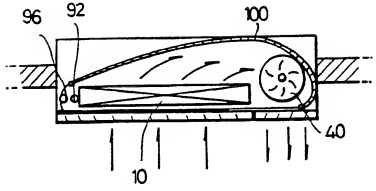

FIG.7B

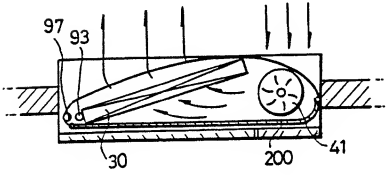

FIG.8 A

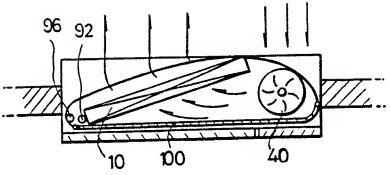

FIG.8 B

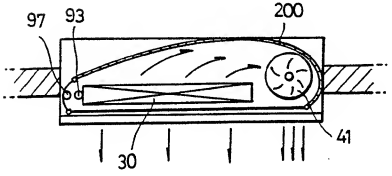

FIG.9A

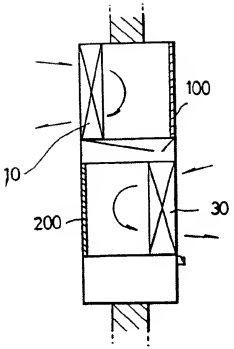

FIG.9B